Nonchemical methods for rice crop insect pest management in Africa

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Introduction

Various rice growing methods are implemented in sub-Saharan Africa. The type of method depends mainly on the irrigation possibilities: rainfed upland and lowland rice, irrigated rice. In the field, amongst the different factors that hamper crop growth and production, insects are often ranked after other constraints associated with water management, low soil fertility, weed infestation (at emergence), nematodes, diseases and birds (at harvest) (AfricaRice, 2011). During storage, Curculionidae species such as *Sitophilus oryzae* are known to be problematic, but an increase in seed production could also give rise to serious problems associated with lepidopterans such as *Sitotroga cerealella* (Togola et al., 2010). In Africa, the identity and diversity of rice pests and their natural enemies in Africa are well known at the field level (Brenière, 1982).
We conducted a survey to determine what nonchemical methods are currently available for managing rice insect pests in sub-Saharan African rice-producing countries (excluding Madagascar).

What has been published about organic rice in Africa?

A search in databases, including the Web of Science (online since 1975) and SCOPUS (since 1960), and the OvidSP platform (queries of AGRICOLA/1970, AGRIS/1991, CAB/1973, ECONLIT/1960 and PASCAL/1984), was carried out to highlight bibliographical references concerning organic rice. This search, using the expression 'ORGANIC RICE', was done on 27 March 2012. A boolean query with the added words 'AFRICA' or 'MADAGASCAR' was also conducted. Two hundred and three references were found when duplicate references were eliminated. Thirty of these concerned insects, mainly in Asia. No literature references on organic rice in Africa were found. The information gathered and presented in this short summary is thus derived from articles published by research experts on IPM in rice cropping conditions in Africa. Only insects causing crop damage in the field were taken into consideration, not those that infest stored rice.

Results on nonchemical pest management methods

Nonchemical management methods that were studied:

- The use of partially resistant varieties. There are indeed between-variety differences in the susceptibility to some pests such as termites (Agunbiade et al., 2009), the Cecidomyidae fly *Orseolia oryzivora*, which is often considered to be a serious pest (Williams et al., 2002; Nwilene et al., 2002) and stemborers (Nwilene et al., 2011). Tolerant varieties do not hamper insect development. Little is known about tolerance and resistance mechanisms except the work by Nwilene et al. (2009). The overcompensation capacities of some varieties, i.e. greater tillering, are involved.
- Strip-cropping rice with maize. Planting rows of rice between four rows of maize (all rows of equal width) leads to a reduction in attacks of stemborers such as *Maliarpha separatella* and

Sesamia calamistis on the rice crops (Nwilene et al., 2011). Diversion of *Sesamia* stemborers towards the maize crop is the suggested mechanism.

- The application of plant extracts such as neem (*Azadirachta indica*) oil has been studied and recommended for controlling termites (Nwilene et al., 2008a).
- Regular weeding and the use of the entomopathogenic fungus *Metarhizium anisopliae* result in lower termite population and damage in rice field (Togola et al., 2012).
- The management of habitats in the immediate vicinity of plots could be carried out by two different approaches: (i) preserving the diversity of natural enemies, predators or parasitoids: planting *Paspalum scrobiculatum* (Poaceae) along the edges of rice crop fields enables the development of *Orseolia bonzii* (Cecidomyidae), which does not harm rice crops. This species is a substitute host of *O. orseolia* parasitoids such as *Platygaster diplosisae* and *Aprostocetus procerae* (Nwilene et al., 2008b); and (ii) eliminating host plants or rice ratoons that facilitate the development or survival of some pests like Diopsides flies (Togola et al., 2011) or gall midges (Williams et al., 2002).

Habitat management on a broader landscape scale has not been studied in Africa. This is of considerable research interest, in line with the studies carried out in Japan by Takada et al. (2012) on the bug *Stenotus rubrovitattus* (Miridae), pests of seeds.

Hence, if certain rules are actually fulfilled, e.g. with respect to organic fertilization or crop rotations, several techniques are potentially available for organic rice production in Africa.

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Appendix Table 1 The main rice pests and nonchemical management methods

Physiological stages (from Brenière, 1982)	Families and species	Nonchemical pest control methods and efficacy[(a)]	References
Herbaceous state (nursery or 1st month)	Coccinellidae (*Chnootriba similis assimilis, Epilachna reticulata*) Pyralidae (*Nymphula depunctalis*)		
Root pests	Termites	Varietal tolerance (+) Neem seed oil (++) Regular weeding (++) *Metarhizium anisopliae* (++)	[2] [5] [12] [12]
	Scarabaeidae (*Heteronychus* spp.) Nematodes		
Tillering			
Foliage	Arctiidae (*Diacrisia scortilla*) Hesperiidae (*Parnara* sp., *Borbo* sp.) Noctuidae (*Spodoptera* spp.) Pyralidae *Marasmia trapezalis* Hispidae (*Hispa unsambarica, Lema* spp., *Trichispa sericea*)	Varietal tolerance (+)	
Sheaths and stems	Cecidomyidae (*Orseolia oryzivora*)	Varietal tolerance (++) Parasitoid conservation (++)	[4,7] [6]
	Diopsidae (*Diopsis apicalis, D. thoracica*)	Ratoon elimination (++)	[11]
	Crambidae (*Chilo zacconius*) Pyralidae (*Eldana saccharina, Maliarpha separatella)*	Strip-cropping (maize) (++)	[8]
Heading	Crambidae (*Chilo zacconius*)	Varietal tolerance (+)	[4]
Stemborers	Noctuidae (*Sesamia calamistis, S. nonagrioides botanephaga, S. nonagrioides penniseti, S. poephaga,* Pyralidae (*M. separatella*, *Scirpophaga* spp.)	Strip-cropping (maize)(++)	[8]
Ripening			
Stemborers	Noctuidae (*Sesamia* spp.) Pyralidae (*Maliarpha separatella, Scirpophaga* spp.) Pentatomidae, Lygaeidae	Varietal tolerance (+)	[4]
Sucking insects	Delphacidae, Jassidae	Varietal tolerance (+++)	

[(a)] +, ++, +++: low to high efficacy